



DECLARATION

I, Tadashi Tsukamoto of 41-8, Utsukushigaoka 3-chome, Aoba-ku, Yokohama, Kanagawa 225-0002, Japan do solemnly and sincerely declare that I well understand both Japanese and English languages.

The translations attached hereto are true and accurate translations of a Proposal Form for Patent Application, an invention disclosure attached in the form of a draft specification to the Proposal Form, and an Order Slip.

I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

This 22<sup>nd</sup> day of September, 2004



Tadashi Tsukamoto

**[Document Name]** Specification (Drafted by NW)

**[Title of the Invention]** WET MULTIPLATE CLUTCH

**[Claims]**

5       **[Claim 1]** A wet multiplate clutch with plural friction plates and plural separator plates arranged alternately each other, wherein between each adjacent ones of said friction plates, plural ones of said separator plates are disposed.

10      **[Claim 2]** A wet multiplate clutch according to claim 1, wherein said plural ones of said separator plates are disposed separably from each other.

15      **[Claim 3]** A wet multiplate clutch according to claim 1 or 2, wherein between said plural ones of said separator plates, a thin member is additionally interposed.

20      **[Claim 4]** A wet multiplate clutch according to any one of claims 1-3, wherein said plural ones of said separator plates have been coated or machined at mutually-opposing surfaces thereof.

**[Detailed Description of the Invention]**

25      **[0001]**

**[Field of the Invention]**

This invention relates to a wet multiplate clutch, which is useful primarily in an automatic transmission.

**[0002]**

25      **[Prior Art]**

FIG. 4 shows one example of wet multiplate clutches. The

wet multiplate clutch designated at numeral 1 is provided with a clutch case 2 and a hub 3, which are rotatable relative to each other. Separator plates 11 and friction plates 5 are spline-fitted on the clutch case 2 and the hub 3, respectively, 5 such that they are movable in an axial direction. The separator plates 11 and the friction plates 5 are alternately arranged one by one.

**[0003]**

**[Object to Be Attained by the Invention]**

10 However, thermal deformations called "heat spots" occur when the above-mentioned wet multiplate clutch is caused to slidingly rotate at high speed. An object of the present invention is to prevent such heat spots.

**[0004]**

**15 [Means for Attaining the Object]**

To attain the above-described object, plural ones of the separators are disposed between each two adjacent ones of the friction plates. Further, these plural ones of the separator plates can be disposed separably from each other, a thin member 20 can be interposed between the plural ones of the separator plates, and/or coating or machining can be applied to mutually-opposing surfaces of the plural ones of the separator plates.

**[0005]**

**25 [Embodiments of the Invention]**

The thickness of a separator plate is considered have an

effect on heat spots as will be expressed by the following formula:

$$\Delta t = \Delta T \cdot w \cdot \alpha$$

where

5            $\Delta t$ : Height of heat spots,

$\Delta T$ : Temperature difference on the surface of the separator plate (i.e., a difference in temperature between the position of a heat spot and other position),

10           w: Thickness of the separator plate, and

$\alpha$ : Coefficient of linear expansion.

The above formula indicates that a separator plate becomes more resistant to the occurrence of heat spots as it becomes thinner. If sliding rotation is continued after the occurrence of heat spots, the bearing stress becomes higher at the positions of the heat spots so that the temperature rises much faster at the positions of the heat spots than at other positions. As a result, the heat spots become still greater.

15           [0006]

20           Two separator plates are disposed between each two adjacent friction plates, and the thickness of each of these separator plates is set at about a half of conventional separator plates. This is to make their total heat capacity substantially equal to the heat capacity of the conventional friction plate, and also to assure providing spline tabs, said spline tabs being maintained in engagement with a clutch case,

with sufficient strength.

[0007]

Further, the plural separator plates used at the same position are disposed separably from each other. The term "separably" as used herein also includes such a case that, even when the separator plates are adhered and fixed with each other with a thin member interposed therebetween, the separator plates can slightly move owing to the elasticity of the thin member and/or an adhesive, to say nothing of such a case that the individual separator plates can completely separate from each other.

[0008]

These thin members are presumed to be effective for heat insulation, damping and impact absorption between the individual separators. The term "damping" as used herein means that separator plates vibrate upon receipt of revolving power. The term "impact absorption" means to act as cushions between the separator plates. When separator plates have asperities, for example, the term "impact absorption" means to absorb bearing stresses at asperities and to facilitate even contact of the separator plate with the other separator plate over the entire surfaces thereof. The term "thin member" as used herein should be construed to embrace thin plates made of rubber, PVC, a resin or a mixture thereof and any other thin members, for example, thin sheets and thin fabrics such as nonwoven fabric, woven fabric and knit fabrics. Preferred examples can include

a variety of paper, sheets, films, and gaskets. More specific examples can include TEFILON sheets, polyimide films, aramid films, fluorinated films, thermosetting resin films, polyoxymethylene films, super engineering plastic fiber films, 5 polyethylene sulfide films, polyetherimide films, polyetherketone films, polyethersulfon films, carbon fiber sheets, silica fiber sheets, mica sheets, and silica paper.

**[0009]**

Further, coatings are considered to have similar effects 10 as the above-described thin members. A coating material is practically the same as an adhesive useful upon adhering the thin members. Specific examples of the coating material can include thermosetting resins, engineering plastics, general-purpose resins, polymer alloys, butadiene nitrile 15 rubber, and high-elasticity resin sheets.

**[0010]**

The term "machined" as used herein means to be machined by shot blasting or shot peening. As a result of this machining, 20 a very small clearance is maintained between the separator plates, bringing about an advantageous effect that the holding of lubricating oil is facilitated. This surface machining is applicable no matter whether thin members such as those described above are interposed.

**[0011]**

25 **[Examples]**

Wet multiplate clutches according to the present

invention are shown in FIG. 1 and FIG. 2, respectively. It is to be noted that, as their basic constructions are substantially the same as the above-mentioned conventional example, like elements of structure will be identified by like numerals. Each 5 wet multiplate clutch 1 is equipped with a clutch case 2 and a hub 3, which rotate relative to each other. Separator plates 11 and friction plates 5 are mounted by spline fitting on the clutch case 2 and the hub 3, respectively. In the example illustrated in FIG. 1 (hereinafter referred to as "the first 10 embodiment"), two separator plates 11 are disposed side by side in a state independent from each other. In the example of FIG. 2 (hereinafter referred to as "the second embodiment"), on the other hand, a TEFLON sheet 12 is interposed between each two separator plates 11. FIG. 3 is a front view of the TEFLON sheet 15 12 and separator plate 11 as viewed from the side A in FIG. 2.

[0012]

Photographs of the conventional product, the first embodiment and the second embodiment after their tests are shown as FIG. 5, FIG. 6 and FIG. 7, respectively. The tests were 20 conducted under the following conditions:

Number of cycles: 2

Initial revolution speed: 8,100 r.p.m.

Inertia force:  $0.196 \text{ kg}\cdot\text{m}^2$

Maximum bearing stress:  $10 \text{ kgf}/\text{cm}^2$

25 Oil temperature at the time of a start:  $100^\circ\text{C}$

Lubrication (from the central axis): 0.18 L/min

Period of engagement: about 0.8 sec

As will be appreciated by taking a look on the photographs, it is understood that heat spots were prevented far more effectively in the wet multiplate clutches of the respective 5 embodiments than in the conventional example. It is also understood that heat spots were prevented more effectively in the wet multiplate clutch of the first embodiment than in the wet multiplate clutch of the second embodiment although the difference in effectiveness was slight.

10 [0013]

**[Advantageous Effects of the Invention]**

The present invention can be practiced in the above-described modes, and are effective for the prevention of heat spots.

15 [Brief Description of the Drawings]

[FIG. 1] An axial cross-sectional view of a wet multiplate clutch according to a first embodiment of the present invention.

20 [FIG. 2] An axial cross-sectional view of a wet multiplate clutch according to a second embodiment of the present invention.

[FIG. 3] A view illustrating the wet multiplate clutch of FIG. 2 as viewed in the direction of arrow A.

25 [FIG. 4] A view illustrating a conventional wet multiplate clutch.

[FIG. 5] A photograph of separator plates in the

conventional example after its test.

【FIG. 6】 A photograph of separator plates in the first embodiment after its test.

【FIG. 7】 A photograph of separator plates in the second  
5 embodiment after its test.

**[Legend]**

- 1      Wet multiplate clutch
- 2      Clutch case
- 3      Hub
- 10     5      Friction plates
- 11     Separator plates
- 12     TEFLON sheets

図 1

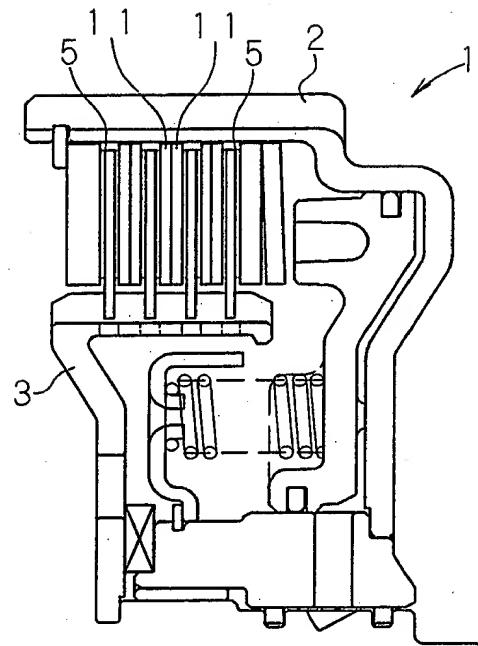


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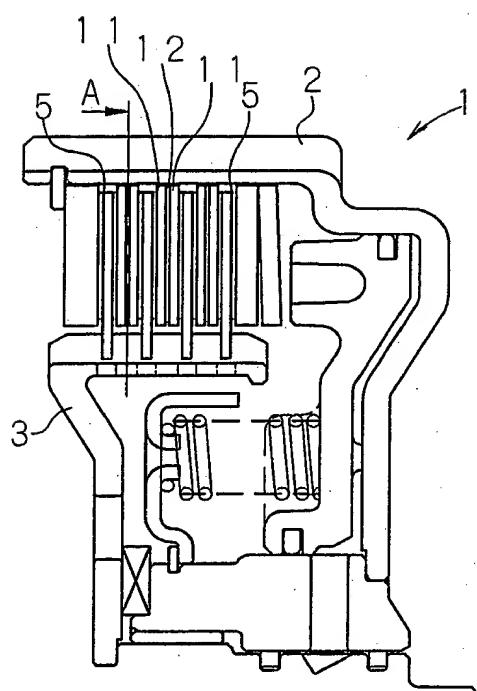


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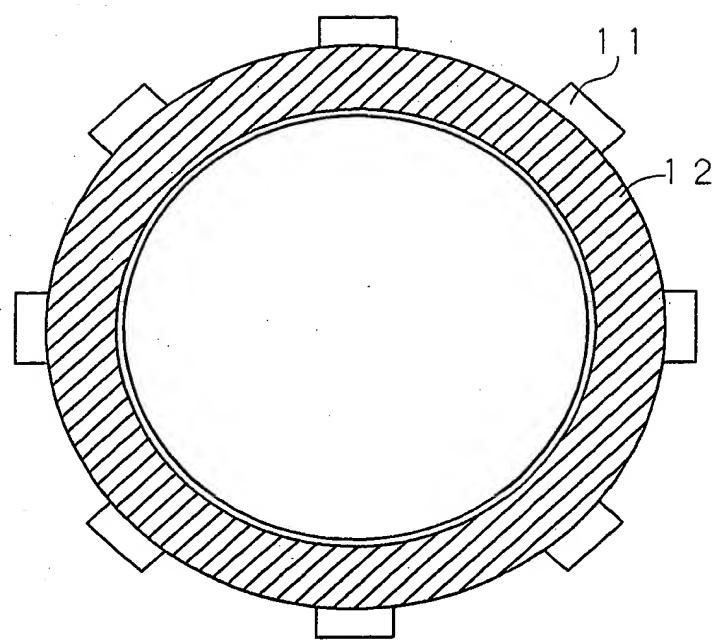
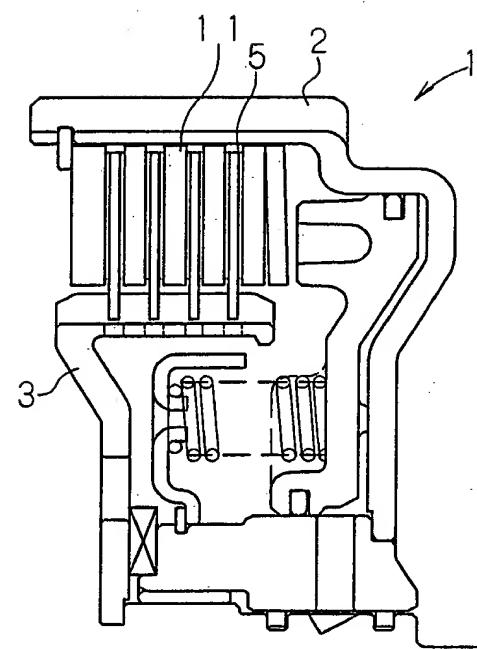
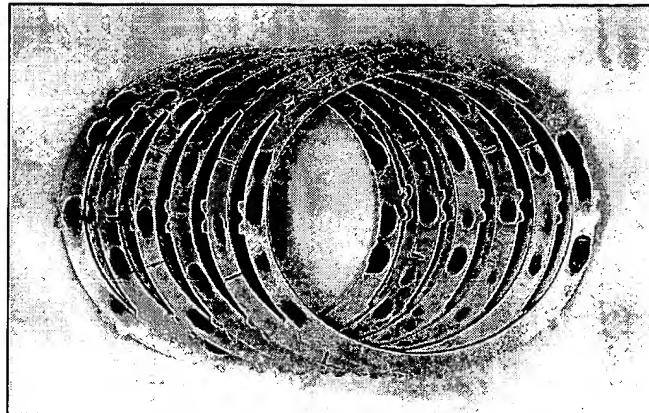


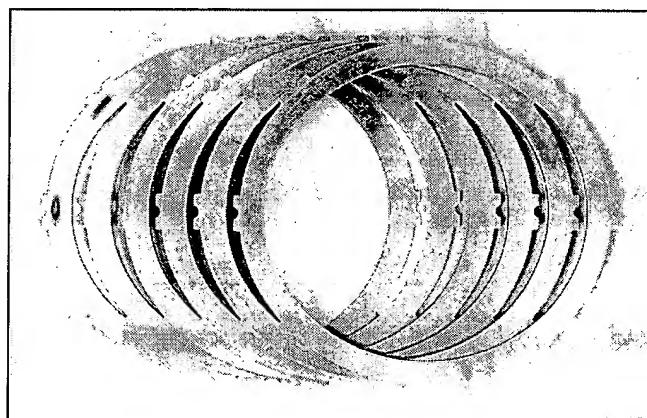
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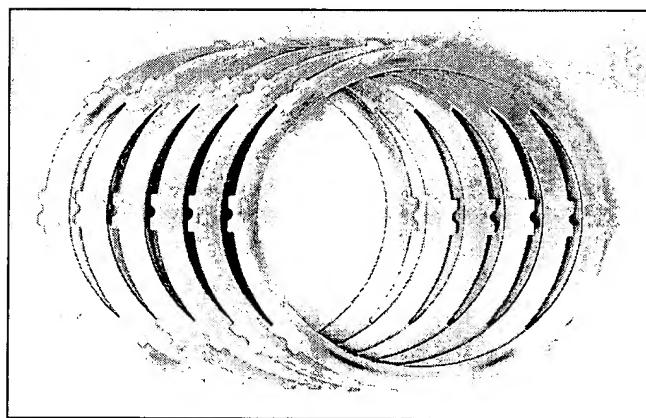
【図 5】



【図 6】



【図 7】



**Proposal Form for Patent Application**  
(and Approval Form)

To: \_\_\_\_\_, Esq.

Manager, Technical Dept.

Patent	Received	No.	NW-53432
U.M.		Date	Month/day/year

<table border="1"> <tr> <td>Supervisors'</td> <td>KINOSHITA</td> <td>SUZUKI, M.</td> <td></td> </tr> <tr> <td>approval stamps</td> <td></td> <td></td> <td></td> </tr> </table>		Supervisors'	KINOSHITA	SUZUKI, M.		approval stamps			
Supervisors'	KINOSHITA	SUZUKI, M.							
approval stamps									
(Proposed: Year/month/day)									
(1) Title of the Invention									
WET MULTIPLATE CLUTCH									
<table border="1"> <tr> <td>(Employee No.)</td> <td>Work unit</td> <td>Address (with phonetic symbols)</td> </tr> <tr> <td>Name (with phonetic symbols)</td> <td></td> <td></td> </tr> </table>		(Employee No.)	Work unit	Address (with phonetic symbols)	Name (with phonetic symbols)				
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Name (with phonetic symbols)									
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<table border="1"> <tr> <td>Details of collaboration</td> <td>(1) Contracted/non-contracted, (2) Joint research, (3) Provision of idea, (4) Others ( )</td> </tr> </table>		Details of collaboration	(1) Contracted/non-contracted, (2) Joint research, (3) Provision of idea, (4) Others ( )						
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<table border="1"> <tr> <td>Reasons for joint appln.</td> <td>Dept./Title ( ) TEL</td> </tr> </table>		Reasons for joint appln.	Dept./Title ( ) TEL						
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<table border="1"> <tr> <td>Our contact in connection with patent application</td> <td></td> </tr> </table>		Our contact in connection with patent application							
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Columns A [to be filled out by inventor(s)]

		Columns A [ to be filled out by Inventor(s) ] (Cont'd)	
(5) Objective of the application		(1) Monopolization of the invention, (2) Assurance of protection on peripheral technology of the invention already made, (3) Restraint to applications by other companies, (4) Marketing strategy, (5) Others ( )	
(6) Outline of the invention	1) Cause, motivation	(1) Own idea, (2) Internal requirement (supervisor's order, request from other department, countermeasure for customer's claim), (3) External demand, (4) Others ( )	
	2) Status of practice	(1) Only idea level, (2) Experimented, (3) Trial manufacture, (4) Others ( )	
	3) Release/publication	(1) Not released, (2) Internally released (Report No. dated M/D/Y), (3) External release scheduled for (M/D/Y) in (name of publication) (others: ), (4) With/without subcontract on research or test (subcontracted on: M/D/Y) (subcontracted to: )	
(7) Related patent publication(s)		JUM-A-51-347, JUM-A-50-40967, JUM-A-50-40962	

					Sufficient, practically sufficient, further improvements needed, insufficient.		
(1) Technical level		High	Medium	Low	(4) Complete-ness	(5) Novelty	(6) Product value
(8) Evaluation of the invention		Cost reduction, <u>improved performance</u> increased marketability, labor saving, mass productivity.			(Novel), similar technology exists, not determined yet.		
(9) Approval/disapproval of application		(1) Approved (2) Disapproved, (3) Further discussion needed.					
(10) Urgency of application		(1) Left to the discretion of Technology Management Section (TMS), (2) Hoped to be filed by: [REDACTED] (Reasons: Wishes to promptly propose to customers as a countermeasure for heat spots on separator plates).					
(11) Possibility of foreign application(s)		(1) To be filed (2) Not determined yet, (3) Not to be filed.			Exist/ <u>Not exist</u>	No. (title of the subject)	
(12) Comments		This invention is believed to be a very effective measure for the prevention of heat spots on separator plate surfaces under high-speed and low-lubrication conditions.			Seal	SUZUKI	
Columns C (to be filled out by TMS)		Processing of application		Give priority, normal, hold (further search, discussion)	Kind of appl'n	Patent, utility model, further study is needed.	
		Special notes				KINOSHITA	NISHIMURA
						HORIUCHI	[REDACTED]
						Handled by	[REDACTED]
						YANAGIHARA	08/08/00

Columns A [to be filled out by supervisor]

Ref. No. NW-5432

RECEIPT ACKNOWLEDGEMENT SLIP

Dated:

To: NSK-Warner K.K.

Your order has been duly received, and will be dealt with while strictly observing the deadline.

Ordered matter	Patent/U.M./ Design/TM application	<sup>B</sup> Professional opinion	
		<sup>C</sup> Opposition	<sup>D</sup> Presentation of information
	<sup>A</sup> Foreign application	<sup>E</sup> Others	
Title	WET MULTIPLATE CLUTCH		
Inventor(s)	Name (with phonetic symbols)		Address (with phonetic symbols)
	GU, Xiaoming		c/o NSK-Warner K.K. 2345, Aino, Fukuroi-shi, Shizuoka
Remarks: Ref. UM-A-50-40962, UM-A-50-40967, UM-A-51-347			
Deadline	M/D/Y	Request for Examination	To be filed/ not to be filed

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Ref. No. NW-5432

ORDER SLIP

Dated:

To: Sunagawa Patent Agency

We request you to deal with the following matter by the below-indicated deadline.

NSK-Warner K.K.

Ordered matter	Patent/U.M./ Design/TM application	<sup>B</sup> Professional opinion	Ordered by:		
		<sup>C</sup> Opposition			
	<sup>D</sup> Presentation of information				
	<sup>A</sup> Foreign application	<sup>E</sup> Others			
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Remarks: Ref. UM-A-50-40962, UM-A-50-40967, UM-A-51-347					
Deadline	M/D/Y; Should be strictly observed	Request for examination	To be filed/ not to be filed		

(Note) Upon completion of the filing procedures, please inform us of our order number and the filing date by telephone.